SUBSTRATE SIZE MONITORING SYSTEM FOR USE IN COPIER/PRINTERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to sheet feeding in copier/printers, and more particularly, to a system for checking for changes in sheet sizes in the paper trays of such machines.

2. Description of Related Art

In a typical electrophotographic printing process, a photoconductive member is charged to a substantially uniform potential so as to sensitize the surface thereof. The charged portion of the photoconductive member is exposed to a light image of an original document being reproduced. Exposure of the charged photoconductive member selectively dissipates the charges thereon in the irradiated areas. This records an electrostatic latent image on the phototconductive member corresponding to the informational areas contained within the original document. After the electrostatic latent image is recorded on the phototconductive member, the latent image is developed by bringing a developer material into contact therewith. Generally, the developer material comprises toner particles adhering triboelectrically to carrier granules to the latent image forming a toner powder image on the photoconductive member. The toner powder image is then transferred from the photoconductive member to a copy sheet. The toner particles are heated to permanently affix the powder image to the copy sheet.

One problem encountered with printers and copiers is unscheduled maintenance calls which can be very costly, and especially, if the unscheduled maintenance calls are initiated by wrong substrate size settings by customers.

After a machine feeds a sheet from a tray, the sheet's travel inside the machine is monitored with paper path sensors that have to be made and cleared

at predetermined times. The time from the sheet's leading edge making a sensor to the trail edge clearing the sensor is nominally the sheet length divided by the transport speed. Obviously, this time is different for different sheet lengths. Machines use predetermined timer values for different sheet lengths and should the sheet length be incorrectly set-up, the result is timing error and machine shutdown. Also, should the sheet's actual width be different from the set-up, the machine will print the spots, undesirably, to the wrong places.

If the size setting for a tray is incorrect, the machine will shutdown continuously at each feed from the tray and if the customer cannot identify the problem to be a simple, (and possibly self-inflected) set-up mismatch, a maintenance engineer may be called. This could happen when the customer has a full service contract that does not add to the customer's direct costs, but the cost is fully realized by the maintenance engineer's employer.

A number of attempts have been made to ensure the correct sheet size settings in machines. For example, customers are encouraged to set up the sizes through the user interface; or set up the sizes with a special indicator in the trays that is read with sensors; or machines are equipped with automatic size sensing systems where the machine has sensors to detect the positions of substrate guides in a tray and from this deduce the size of substrates in the tray.

U.S.Patent 4,475,732 issued October 9, 1984 to Clausing et al. discloses in FIG. 3 the use of a stack height sensor in a sheet feeding and separating apparatus with the sensor incorporating a plunger having a flag attached to a shoulder thereof that blocks and unblocks an optoelectric sensor as the plunger is moved in a vertical direction.

While the above-mentioned attempts to ensure the correct sheet size settings in machines have been useful, there is still a need for low cost improvements.

SUMMARY OF THE INVENTION

Accordingly, pursuant to the features of the present invention, an improved system to detect if the positions of a tray's sheet guides have been

changed while the tray has been open is disclosed that answers the above-mentioned problem by providing a spring loaded stud in the tray that is pushed and locked into an 'in' position every time the tray is pushed in. When the tray is pulled out, if the size guides are moved, the spring-loaded stud is released with a linkage mechanism from the guides to the stud. The stud actuates a sensor flag, and as the tray is pushed home, a sensor checks the flag and a control system subsequently deduces whether the guides have been moved.

These and other features and advantages of the invention are described in or apparent from the following detailed description of the exemplary embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the instant invention will be apparent and easily understood from a further reading of the specification, claims and by reference to the accompanying drawings in which like reference numerals refer to like elements and wherein:

FIG. 1 is a schematic elevational view of a typical electrophotographic printing machine utilizing the substrate size monitoring system of the present invention.

FIG. 2 is a partial schematic plan view of a paper tray shown in **FIG. 1** showing the tray in a closed, open and closed position when sheet size is not adjusted.

FIG. 3 is a partial schematic plan illustration of a paper tray in **FIG. 1** showing the tray in a closed, open and closed position when sheet size is adjusted.

DETAILED DESCRIPTION OF THE INVENTION

While the present invention will be described in connection with a preferred embodiment thereof, it will be understood that it is not intended to limit the invention to that embodiment. On the contrary, it is intended to cover all

alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

For a general understanding of the features of the present invention, reference is made to the drawings. In the drawings, like reference numerals have been used throughout to identify identical elements. **FIG. 1** schematically depicts an electrophotographic printing machine incorporating the features of the present invention therein. It will become evident from the following discussion that the sheet size monitoring device of the present invention may be employed in wide variety of devices and in not specifically limited in its application to the particular embodiment depicted herein.

FIG. 1 illustrates an original document positioned in a document handler **27** on a raster input scanner (RIS) indicated generally by the reference numeral **28**. The RIS contains document illumination lamps; optics, a mechanical scanning drive and a charge coupled device (CCD) array. The RIS captures the entire original document and converts it to a series of raster scan lines. This information is transmitted to an electronic subsystem (ESS) which controls a raster output scanner (ROS) described below.

FIG. 1 schematically illustrates an electrophotographic printing machine, which generally employs a photoconductive belt **10**. Preferably, the photoconductive belt 10 is made from a photoconductive material coated on a ground layer, which, in turn, is coated on an anti-curl backing layer. Belt **10** moves in the direction of arrow **13** to advance successive portions sequentially through the various processing stations disposed about the path of movement thereof. Belt **10** is entrained about stripping roller **14**, tensioning roller **16** and drive roller **20**. As roller **20** rotates, it advances belt **10** in the direction of arrow **13**.

Initially, a portion of the photocondctive surface passes through charging station A. At charging station A, a corona generating device indicated generally by the reference numeral **22** charges the photoconductive belt **10** to a relatively high, substantially uniform potential.

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At an exposure station, B, a controller or electronic subsystem (ESS), indicated generally by reference numeral **29**, receives the image signals representing the desired output image and processes these signals to convert them to a continuous tone or greyscale rendition of the image which is transmitted to a modulated output generator, for example a raster output scanner (ROS), indicated generally by reference numeral **30**. Preferably, ESS **29** is a self-contained, dedicated minicomputer. The image signals transmitted to ESS **29** may originate from a RIS as described above or from a computer, thereby enabling the electrophotographic printing machine to serve as a remotely located printer for one or more computers. Alternatively, the printer may serve as a dedicated printer for a high-speed computer. The signals from ESS **29**, corresponding to the continuous tone image desired to be reproduced by the printing machine, are transmitted to ROS **30**. ROS **30** includes a laser with rotating polygon mirror blocks. The ROS will expose the photoconductive belt to record an electrostatic latent image thereon corresponding to the continuous tone image received from ESS **29**. As an alternative, ROS **30** may employ a linear array of light emitting diodes (LEDs) arranged to illuminate the charged portion of photoconductive belt **10** on a raster-by-raster basis.

After the electrostatic latent image has been recorded on photoconductive surface **12**, belt **10** advances the latent image to a development station, C, where toner, in the form of liquid or dry particles, is electrostatically attracted the latent image using commonly known techniques. The latent image attracts toner particle from the carrier granules forming a toner powder image thereon. As successive electrostatic latent images are developed, toner particles are depleted from the developer material. A toner particle dispenser, indicated generally by the reference numeral **39**, dispenses toner particles into developer housing **40** of developer unit **38**.

With continued reference to **FIG. 1**, after the electrostatic latent image is developed, the toner powder image present on belt **10** advances to transfer station D. A print sheet **48** is advanced to the transfer station, D, by a sheet feeding apparatus, **50**. Preferably, sheet feeding apparatus **50** includes a feed

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roll **52** contacting the uppermost sheet of stack **54**. Feed roll **52** rotates to advance the uppermost sheet from stack **54** into vertical transport **56** from tray one of similar trays 55. Vertical transport **56** directs the advancing sheet **48** of support material into registration transport **125** past image transfer station D to receive an image from photoreceptor belt **10** in a timed sequence so that the toner powder image formed thereon contacts the advancing sheet **48** at transfer station D. Transfer station D includes a corona generating device **58**, which sprays ions onto the backside of sheet **48**. This attracts the toner powder image from photoconductive surface **12** to sheet **48**. After transfer, sheet **48** continues to move in the direction of arrow **60** by way of belt transport **62**, which advances sheet **48** to fusing station F.

Fusing station F includes a fuser assembly indicated generally by the reference numeral **70** which permanently affixes the transferred toner powder image to the copy sheet. Preferably, fuser assembly **70** includes a heated fuser roller **72** and a pressure roller **74** with the powder image on the copy sheet contacting fuser roll **72**. The pressure roller is cammed against the fuser roller to provide the necessary pressure to fix the toner powder image to the copy sheet. The fuser roll is internally heated by a quartz lamp (not shown). Release agent, stored in a reservoir (not shown), is pumped to a metering roll (not shown). A trim blade (not shown) trims off the excess release agent. The agent transfers to a donor roll (not shown) and then to the fuser roll **72**.

The sheet then passes through fuser **70** where the image is permanently fixed or fused to the sheet. After passing through fuser **70**, a gate **80** either allows the sheet to move directly via output **16** to a finisher or stacker, or deflects the sheet into the duplex path **100**, specifically, first into single sheet inverter **82** here. That is, if the sheet is either a simplex sheet or a completed duplex sheet having both side one and side two images formed thereon, the sheet will be conveyed via gate **80** directly to output 84. However, if the sheet is being duplexed and is then only printed with a side one image, the gate **80** will be positioned to deflect that sheet into the inverter **82** and into the duplex loop path **100**, where that sheet will be inverted and then fed to acceleration nip **102** and

belt transports **110**, for recirculation back through transfer station D and fuser **70** for receiving and permanently fixing the side two image to the backside of that duplex sheet, before it exits via exit path **84**.

After the print sheet is separated from photoconductive surface **12** of belt **10**, the residual toner/developer and paper fiber particles adhering to photoconductive surface **12** are removed therefrom at cleaning station E. Cleaning station E includes a rotatably mounted fibrous brush in contact with photoconductive surface **12** to disturb and remove paper fibers and a cleaning blade to remove the nontransferred toner particles. The blade may be configured in either a wiper or doctor position depending on the application. Subsequent to cleaning, a discharge lamp (not shown) floods photoconductive surface **12** with light to dissipate any residual electrostatic charge remaining thereon prior to the charging thereof for the next successive imaging cycle.

The various machine functions are regulated by controller **29**. The controller is preferably a programmable microprocessor, which controls all of the machine functions hereinbefore described. The controller provides a comparison count of the copy sheets, the number of documents being recirculated, the number of copy sheets selected by the operator, time delays, jam corrections, etc. The control of all of the exemplary systems heretofore described may be accomplished by conventional control switch inputs from the printing machine consoles selected by the operator. Conventional sheet path sensors or switches may be utilized to keep track of the position of the document and the copy sheets.

Turning next to **FIG.2**, a detailed illustration of the substrate size monitoring system of the present invention is illustrated showing a tray **55** in an initially closed position as indicated by tray home signal 1ine **120** and is bracketed by machine guides **93** and **94**. A sensor **92** is positioned below machine guide **93** and is in communication with controller **29** to give off a change of direction signal **130**. Tray **55** includes side guides **90** and **91** that are adjusted in accordance with the size of substrates or sheets placed into the tray. Tray **55** also includes a stud **95** loaded by spring **96**. Stud **95** has a flag **97** attached

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thereto, such that, movement of the stud causes the flag to rotate in a clockwise or counter-clockwise direction.

As shown in **FIG. 2**, Tray **55** is initially in a home position as indicated by tray home signal **128**. As the tray is pulled out from the machine the tray home signal **128** is changed as indicated by line **120** and after the tray is returned to the home position the tray home signal is back at **128**. In **FIG. 2**, side guides **90** and **91** have not been adjusted and flag **97** does not make or cover sensor **92** during withdrawal or insertion of tray **55** into the machine. This is indicated by change detection signal **130** being in a straight line continuously during movement of the tray.

In **FIG. 3**, Tray **55** is in a home position as indicated by tray home signal **128** with side guides **90** and **91** set for the substrate size already in the tray. The tray is moved out and side guides **90** and **91** are set for substrates of a different dimension. Side guides **90** and **91** are connected to spring loaded stud **95** through a conventional linkage mechanism (not shown) such that as the side guides are adjusted the stud is released and thereby rotating flag **97** in a counter-clockwise direction. As the tray is pushed back into the machine, flag **97** makes sensor **92** which gives off a change detection signal indicated at **135** and controller **29** subsequently deduces whether the guides have been moved. Once the machine, through controller **29**, knows that the side guides have been adjusted it sends a signal to the machine's user interface and the customer is requested to set-up the size and prohibit usage of the tray unless the size is set. Continued movement of tray **55** into its home position causes stud **95** to hit stationary member **98** and reset to its home position.

Should a customer fail to set-up the size correctly, the substrate size monitoring system of the present invention will help the service engineer to interrogate the situation better using remote inactive diagnostics, possibly eliminating the need for a site visit. This system also enables the customer to solve more problems by using the user interface.

In conclusion, disclosed is a paper tray that includes spring-loaded mechanism that can be in one of two positions. The mechanism is released

whenever paper tray adjustments are made. The released mechanism triggers a sensor forcing a dialogue on the user interface, forcing the user to select the paper size, thereby avoiding jams. The sensor is triggered and the mechanism is latched as the paper tray is inserted.

While the invention has been described in conjunction with the specific embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth above are intended to be illustrative and not limiting. Various changes may be made without departing from the spirit and scope of the invention as defined herein.

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